Future Plans for STAR

T. Hallman

QCD at RHIC:
Workshop on Heavy Ions for the Next Decade
Brookhaven National Laboratory
October 27-28, 2000

STAR — A Perspective on the Future

The Basis — Consideration by the STAR Collaboration of:

- Compelling science to be accomplished with STAR, taking into account
  - Key signatures and measurements for QGP discovery and exploration
  - Seminal measurements to be accomplished with polarized protons
  - Known increase of STAR scientific reach as a function of time
  - Projected upgrades of RHIC luminosity and RCF capability
  - Possible upgrades of the STAR detection capability

- Process guided and information collated by the STAR Long Range Plan Committee
  - Rene Bellwied (Wayne State) Chair
  - Les Bland (Indiana)
  - Daniel Ferenc (UC Davis)
  - Huan Huang (UCLA)
  - Peter Jacobs (LBNL)
  - Gerd Kunde (Yale)
  - Mike Lisa (Ohio State)
  - Bill Llope (Rice)
  - Thomas Ullrich (Yale)
  - Howard Wieman (LBNL)

Ex-Offcio: Harris, Marx, Hallman

Framing the Picture:

For the STAR relativistic heavy ion program, three (rough) time frames considered:

- **Discovery Phase** — **present until 2003**
- **Exploration and Characterization of the QGP** — **2003 — 2006**
- **Building on new-found knowledge & the search for rare processes** — **2006 — ?**

Main Physics thrust:

Inclusive spectra
Particle correlations and fluctuations
Event-by-event Physics
pA studies
Heavy flavor
Jets and high p_t
Peripheral collisions

For the STAR spin physics program

- **More or less continuous program development beginning in 2001**

Main Physics thrust:

Transverse asymmetries A_N
Gluon polarization, $\Delta G(x)$
Sea quark , anti-quark pol. Δu, $\Delta \bar{u}$, Δd, $\Delta \bar{d}$
Very high p_t jets (parity violation)

STAR — The Discovery Phase (Present - 2003)

Continuation of initial scientific program to measure:

- inclusive spectra, particle correlations and fluctuations vs A,B, √s to study

  strangeness, entropy, mean pt, source size & dynamics, flow, particle ratios, in medium effects, stopping, baryo-chemical potential, flavor equilibrium, temperature, thermalization……

Plus, phasing in enhancements to extend the scientific reach of STAR for measuring:

- jet's, direct photons, moderate and high pt (jet quenching)
- structure functions, pA observables
- event-by-event flavor composition/fluctuations
- event-by-event DCC search
- high mass vector mesons
- spin asymmetries

To be accomplished with: (in additional to baseline STAR Detector)

• Completed full acceptance Barrel EMC with pre-shower	$3.0 M
• Completed of Endcap Electromagnetic Calorimeter	NSF
• Barrel Time of Flight Detector (MRPC technology)	~ $5.0 M
• Photon Multiplicity Detector	VECC
• DAQ/Trigger upgrade	Cap
• VPD & upgraded ZDC's (?)	Cap
• R&D for next phase	$2.0 M
	~ $ 10 M

STAR — Exploration & Characterization of the QGP (2003 - 2006)

Continuation of scientific program; increasing emphasis on hard scattering:

- jets, direct photons, di-jets, photon + jet, vs A,B, √s
- vector bosons

Parton energy loss, pA scaling, structure functions, mini-jets, initial conditions ...
gluon polarization, sea quark & anti-quark polarization, parity violation, transversity...

Plus, phasing in enhancements to extend the scientific reach of STAR for measuring:

- open charm
- flavor tagging of jets
- existing observables extended to forward pseudo-rapidity
- pomeron-pomeron interactions

To be accomplished with: (in additional to existing STAR Detector)

• Inner Tracking Detector	~ $3.0 M
• Forward Physics Upgrade Package	
• Forward Silicon Detector	~ $3.0 M
• Forward Trigger Barrel	~ $0.5 M
• Forward RICH	~ $1.0 M
• DAQ/Trigger upgrade	~ $2.0 M
• Mid-rapidity Trigger and PID Upgrade (STT, CRD)	~ $2.0 M
• Roman Pots	~ $0.5 M
• R&D for next phase	~ $2.0 M
	~ $ 14 M

STAR - Building on new knowledge; Search for Rare Processes (2006 - ?)

Continuation of scientific program; direction driven by what has been learned as well as upgraded luminosity:

Possible enhancements to extend the scientific reach of STAR for measuring:

- rare hadronic probes (J/Ψ, Υ, open charm, B-mesons) vs A,B, $\sqrt{s}$
- very high pt jets
- flavor tagging of forward jets

To be accomplished with: (in additional to existing STAR Detector)

• Solid State TPC Replacement	~ $15.0 M
• Transition Radiation Tracker	~ $8.0 M
• DAQ/Trigger upgrade	~ $5.0 M
• Central RICH Barrel	~ $6.0 M
• Completion of Forward RICH	~ $2.0 M
	~ $ 36 M

Conclusions

- **STAR has a robust startup capability and is already producing and publishing important scientific results — the next 5-6 years will be really exciting !**
- **In the time between now and 2005, to realize the scientific investment in STAR we need to "run the program" meaning it is essential to have good support (operating and capital equipment funding) for:**
  - **Sufficient running time (heavy ions and spin)**
  - **Maintaining a robust Operations Group**
  - **Finishing the STAR EM Calorimeters (Highest STAR Equipment Priority at present)**
  - **Continued development of RCF and PDSF/NERSC Capability**
  - **Providing adequate user support**
  - **Installation of additional detectors "now on the books"**
  - **Continued prototyping, development for enhancements of the STAR baseline capability and next generation capability (detectors, Trigger, DAQ, RCF) (Discovery phase ~ $10M) (Exploration & Characterization Phase ~ $14M)**
  - **Constructing the next generation of STAR Detectors (beyond 2006) which will build on what we have learned (placeholder ~ $ 36M).**

Conclusions

- **The real story is just beginning; the most important successes and the most exciting discoveries are in the future**
- **Through 2006, and beyond, there continues to be a significant challenge to meet the full potential of the STAR scientific program**
- **Continued strong support and appropriate levels of funding are necessary to meet that challenge**